

A modified false vocal fold flap for functional reconstruction after frontolateral partial laryngectomy: a comparison with conventional open resection and laser cordectomy

Die erweiterte Taschenbandplastik zur funktionellen Rekonstruktion bei frontolateralen Kehlkopfteilresektionen im Vergleich mit konventionell offen resezierten und laserchordektomierten Patienten

Abstract

Objective: To describe a modified flap technique (MFT) involving the use of a false vocal fold flap for glottic reconstruction and the removal of arytenoid cartilage and to compare it with conventional frontolateral partial laryngectomy (FLPL) and laser cordectomy (LC).

Methods: Twenty-eight MFT, 13 FLPL and 12 LC patients completed a standardised questionnaire for assessing aspiration, respiration, quality of life, and subjective voice quality. We analysed vocal function in terms of roughness, breathiness and hoarseness, measured voice range profiles, and performed videoendoscopy.

Results: No patient reported respiratory problems. Aspiration occurred in 33.3% (MFT), 41.6% (FLPL) and 16.6% (LC). Voice quality was rated as good/satisfactory by 17 MFT patients (62%), satisfactory/sufficient by 69% of FLPL patients, and sufficient/poor by 75% of LC patients.

Conclusions: The modified false vocal fold flap effectively covers defects and creates a neocord that ensures good phonatory rehabilitation and has positive effects on postoperative quality of life.

Keywords: partial laryngectomy, laser cordectomy, voice quality, quality of life

Kai J. Lorenz¹
Roland Kohnle¹
Heinz Maier¹

1. Department of
Otolaryngology/Head and
Neck Surgery, German Armed
Forces Hospital of Ulm, Ulm,
Germany

Zusammenfassung

Hintergrund: Vergleich einer neuen Technik zur Rekonstruktion der Neoglottis mit Aryknorpel-Resektion (mTBP) im Vergleich zur konventionellen Teilresektion (FLKT) und Laserchordektomie.

Material/Methoden: 28 Patienten (mTBP), 13 Patienten (FLKT) und 12 Patienten (Laser) wurden mittels eines standardisierten Fragebogens zu Aspirationsproblematik, Atmungsbeschwerden, peri- und postoperativer Lebensqualität sowie subjektiver Stimmqualität befragt. Ferner erfolgten eine Analyse der Stimmfunktion nach dem RBH-Schema, eine Stimmfelduntersuchung und eine Videoendoskopie.

Ergebnisse: Keine Beschwerden bezüglich der Atmung. Hinsichtlich der Atmung wurden in keiner Gruppe postoperative Beschwerden angegeben. Aspiration bei 33,3% (mTBP), 41,6% (FLKT), 16,6% (Laser). Stimmqualität: mTBP 17 Patienten (62%) gut bis befriedigend, FLKT 69% befriedigend bis ausreichend, Laser 75% ausreichend bis schlecht.

Schlussfolgerung: Die erweiterte Taschenbandplastik zur Glottisrekonstruktion nach frontolateraler Kehlkopfteilresektion ermöglicht neben einer guten Defektdeckung, die Ausbildung eines suffizienten Ersatzstimmbandes mit einer guten phonatorischen Rehabilitation, die sich auch positiv auf die postoperative Lebensqualität auswirkt.

Schlüsselwörter: partielle Kehlkopfteilresektion, Laserchordektomie, Stimmqualität, Lebensqualität

Introduction

Small T1 and T2 glottic carcinomas are usually resected by transoral laser cordectomy. During the past ten to fifteen years, this approach has become the established standard in Germany too [1], [2]. A transoral procedure decreases postoperative morbidity and makes temporary tracheostomy unnecessary in many cases [3]. It, however, requires good visibility of the entire glottic region and especially the tumour-bearing areas. In addition, the presence of cartilage infiltration must be thoroughly ruled out and the mobility of both arytenoids must be ensured. The transoral procedure also requires that the surgeon be well trained in microscope-assisted laser surgery for tumours.

Frontolateral partial laryngectomy continues to be an excellent alternative treatment for patients with T1a tumours and small T2 tumours of the glottis who are not candidates for rigid endoscopy or curative resection with clear margins (R0 resection). In these cases, tumours are excised via a thyrotomy, which allows surgeons to thoroughly explore the tumour-bearing vocal cord. Following resection, residual defects are usually left to heal by granulation or are covered with split-thickness skin grafts. Phonatory outcome following this procedure, however, is unsatisfactory since no neocord is created. This technique was modified by Conley [4], [5], who mobilized the ipsilateral false vocal fold and used portions of it for covering defects. Disadvantages of this procedure are postoperative aspiration symptoms and partially unsatisfactory phonatory outcomes that are caused by the inferior displacement of the ipsilateral arytenoid cartilage after forced mobilisation. In addition, the literature describes medialisation techniques that are used either during primary procedures or during secondary procedures and involve transoral injections for scar tissue augmentation. Primary medialisation can be done by glottic reconstruction with thyroid cartilage strips [4], [5], [6], [7], false vocal fold displacement [8], [9], [10], or the submucosal placement of a muscle flap [11]. The objective of these techniques is to reconstruct the anterolateral portion of the glottis, which plays a key role in the quality of voicing. Surgical reconstruction of the glottis must ensure the presence of an adequate diameter of the laryngeal lumen for respiration, an appropriate volume, and a soft-tissue basis for reepithelialisation of the neoglottis for voice rehabilitation. Further objectives of surgery must be to ensure safe swallowing and to prevent aspiration.

In the study presented here, we describe a procedure that involves the mobilisation of the false vocal fold for glottic reconstruction via a cranial approach and the additional resection of the ipsilateral arytenoid cartilage. This procedure allows us to obtain more mucosa for covering larger defects and at the same time prevents

the inferior displacement of the arytenoid into the laryngeal entrance.

Twenty-eight patients underwent this procedure and postoperatively completed a standardised questionnaire that assessed aspiration symptoms, respiration and subjective voice quality. First results are presented here and compared with those obtained for patients who underwent conventional frontolateral partial laryngectomy as described by Conley (n=13) and patients who were treated by transoral laser cordectomy (n=12).

Compared with transoral laser resection and open resection without glottic reconstruction, the modified false vocal fold flap technique is associated with better voice rehabilitation and fewer aspiration symptoms.

Materials and methods

The study included 28 patients (median age: 60.2 years; tumour stage: T1a=3, T1b=14, T2=11) who underwent the modified flap technique (MFT), 13 patients (median age: 56.4 years; tumour stage: T1b=8, T2=5) who underwent conventional frontolateral partial laryngectomy (FLPL) as described by Conley, and 12 patients (median age: 58.7 years; tumour stage: T1a=10, T2=2) who underwent transoral laser cordectomy (LC) (Table 1). All patients gave written informed consent to the study. The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional guidelines on human experimentation (Ethikkommission Universität Ulm) and with the Helsinki Declaration of 1975, as revised in 2008.

All patients were evaluated by videostroboscopy. An examiner with special training in phoniatrics assessed voice quality in terms of roughness, breathiness and hoarseness and determined the type of phonation. The voice assessment was performed blinded so that the examiner wasn't able to recognise the patient.

Voice range profiles were measured while the patients were reading aloud the German version of "The North Wind and the Sun". An automatic measurement system (Homoth 2000) was used to assess dynamic ranges and frequency ranges during reading and during speaking and shouting. For a measurement of maximum phonation times, the patients were asked to phonate the vowel "a" three times and the results were averaged.

Incidence and graduation of aspiration was assessed by transnasal flexible endoscopy and blue dyed yogurt swallowing as well as videofluoroscopy.

A specially designed questionnaire was used to ask the patients about aspiration symptoms, subjective voice quality, respiration, and postoperative quality of life in a standardised format.

Table 1: Patient characteristics

	Laser cordectomy	Modified flap technique	Frontolateral partial laryngectomy
Gender (male/female)	12/0	27/1	13
Mean age (years)	58.7	60.2	56.4
T1a tumour	10	3	0
T1b tumour	0	14	8
T2 tumour	2	11	5

Table 2: Types of phonation as assessed by endoscopy (Type I = vocal folds, Type II = vocal fold against scar, Type III = false vocal folds, Type IV = arytenoid cartilage against epiglottis)

	Type I	Type II	Type III	Type IV
Laser cordectomy	4 (33%)	8 (67%)	0 (0%)	0 (0%)
Frontolateral partial laryngectomy	0 (0%)	10 (77%)	2 (15%)	1 (8%)
Modified flap technique	0 (0%)	25 (89%)	2 (7.5%)	1 (3.5%)

Surgical technique

Following a vertical skin incision, the prelaryngeal muscles were divided and the laryngeal skeleton was exposed. Following the elevation of a perichondrial flap, the larynx was opened with bilateral paramedian incisions through the thyroid cartilage. The vocal cord was resected. Following the exposure of the false vocal fold and the submucosal exposure of the arytenoid cartilage, the arytenoid cartilage was completely removed. The false vocal fold flap was pulled down and attached to the subglottic resection line and in the region of the anterior thyroid cartilage with absorbable sutures. The wound was closed in layers.

Results and analysis

Flexible transnasal laryngoscopy revealed Type II compensatory phonation (vocal fold against scar) in 77% of the patients who underwent conventional surgery (FLPL), Type III compensatory phonation (false vocal folds) in 15% of the FLPL patients, and Type IV compensatory phonation (arytenoid cartilage against epiglottis) in 8% of the patients. Type II phonation was noted in 89% of the patients who underwent the modified flap technique (MFT), Type III phonation in 7.5%, and Type IV in 3.5% of the MFT patients. Laryngoscopy revealed Type I phonation (vocal folds) in 33% and Type II phonation in 67% of the laser cordectomy patients (Table 2). The neocord was judged as good in 31%, satisfactory in 15%, and sufficient in 54% of the patients who underwent conventional surgery (FLPL). In the group of patients who underwent the modified flap technique (MFT), the neocord was good in 60% and satisfactory in 32%. No patient reported dyspnoea on exertion or at rest.

Expert assessment of phonation

The assessment of voice quality in terms of roughness (R), breathiness (B) and hoarseness (H) (12) showed that laser cordectomy patients had roughness and hoarseness scores indicative of a mild or moderate voice disorder (R=1.75, B=1.53, H=1.66). Patients who underwent the modified flap technique had scores that indicated a moderate voice disorder (R=1.72, B=1.64, H=1.86) (Table 3). Patients who underwent conventional partial resection showed scores indicative of a moderate or severe voice disorder (R=2.15, B=1.84, H=2.3).

Voice range profiles

Maximum phonation times were 9.1 seconds after laser cordectomy, 11.1 seconds after conventional partial resection, and 11.5 seconds after the modified flap technique (Table 4).

During the reading task, patients had a frequency range of 17.4 semitones after laser cordectomy, 13.7 semitones after conventional partial resection, and 13.8 semitones after the modified flap technique. During speaking and shouting, we measured frequency ranges of 11.2 semitones after laser surgery, 10.5 semitones after conventional partial resection, and 11 semitones after the modified flap technique.

During the reading task, patients had dynamic ranges of 28.3 dB after laser surgery, 24.3 dB after conventional partial resection, and 19.1 dB after the modified technique. During speaking and shouting, we measured dynamic ranges of 31.2 dB after laser cordectomy, 29 dB after conventional partial resection, and 23.4 dB after the modified technique (Table 5).

Table 3: Expert (phoniatrist) assessment of voice quality in terms of roughness, breathiness and hoarseness (LC = laser cordectomy, FLPL = frontolateral partial laryngectomy, MFT = modified flap technique, SD = standard deviation)

	Roughness			Breathiness			Hoarseness		
	LC	FLPL	MFT	LC	FLPL	MFT	LC	FLPL	MFT
Mean	1.75	2.15	1.72	1.53	1.84	1.64	1.66	2.3	1.86
SD	0.62	0.86	0.68	0.9	0.76	0.6	0.77	0.46	0.49

Table 4: Maximum phonation times in seconds. Patients were asked to phonate the vowel “a” three times. The averaged results are presented in the table. (LC = laser cordectomy, FLPL = frontolateral partial laryngectomy, MFT = modified flap technique, SD = standard deviation)

	Phonation time		
	LC	FLPL	MFT
Mean	9.1	11.1	11.5
SD	4.6	7.5	5.9

Table 5: Voice range profiles (SD = standard deviation, LC = laser cordectomy, FLPL = frontolateral partial laryngectomy, MFT = modified flap technique)

	Frequency range (semitones) during reading			Frequency range (semitones) during speaking and shouting		
	LC	FLPL	MFT	LC	FLPL	MFT
Mean	17.4	13.7	13.8	11.2	10.5	11
SD	6.5	5.6	4.8	1.5	0.75	3.1
	Dynamic range (dB(A)) during reading			Dynamic range (dB(A)) during speaking and shouting		
	LC	FLPL	MFT	LC	FLPL	MFT
Mean	28.3	24.3	19.1	31.2	29	23.4
SD	6.4	5.6	6.05	3.1	14.6	4.5

Subjective questionnaire-based assessment of voice quality

Standardised voice quality questionnaires were completed by patients and family members or friends and revealed better quality-of-voice outcomes for patients who underwent the modified flap technique than for the other patients.

At the time of the examination (6 to 74 months after surgery), voice quality was rated as good by 25%, as satisfactory by 42.8%, as sufficient by 28.5%, and as poor by 7.1% of the patients who underwent the modified technique. Of the patients who underwent conventional surgery, 7.7% judged the quality of their voice as good, 30.8% as satisfactory, 46.2% as sufficient, and 15.4% as poor. After laser cordectomy, voice quality was rated as good by 8.3% of the patients, as satisfactory by 16.7%, as sufficient by 41.7%, and as poor by 33.3%. Similar results were obtained when the patients rated the quality of their voice when speaking softly or loudly. Speaking at a loud level was associated with poorer results (Table 6).

When the questionnaire was completed by family members or friends, the quality of the voice of patients who underwent the modified technique was rated as good by 35.7%, as satisfactory by 35.7%, as sufficient by 17.9%, and as poor by 7.1%. Of the family members or friends of conventional surgery patients, 15.4% judged voice quality as good, 38.5% as satisfactory, 38.5% as sufficient, and 7.7% as poor. The voice quality of patients after laser cordectomy was rated as good by 41.7%, as satisfactory by 0%, as sufficient by 25%, and as poor by 33.3% (Table 7).

Respiratory problems

When asked about postoperative respiratory problems in everyday situations, 23% of the patients who underwent conventional surgery reported that they never had respiratory problems, 31% experienced problems rarely, 38% occasionally, and 8% always. Patients who underwent the modified technique never (28%), rarely (38%) or occasionally (34%) had surgery-related respiratory problems.

Table 6: Assessment of voice quality by patients using a standardised questionnaire (LC = laser cordectomy, FLPL = frontolateral partial laryngectomy, MFT = modified flap technique)

How do you rate your voice quality?						
Before surgery						
	Very good	Good	Satisfactory	Sufficient	Poor	Very poor
LC	0	7	3	1	1	0
FLPL	1	6	2	4	0	0
MFT	4	12	5	5	2	0
At present						
	Very good	Good	Satisfactory	Sufficient	Poor	Very poor
LC	0	1	2	5	4	0
FLPL	0	1	4	6	2	0
MFT	0	7	11	8	2	0
Soft speech						
	Very good	Good	Satisfactory	Sufficient	Poor	Very poor
LC	0	4	3	5	1	0
FLPL	0	2	5	6	0	0
MFT	0	10	12	6	0	0
Loud speech						
	Very good	Good	Satisfactory	Sufficient	Poor	Very poor
LC	0	3	0	2	5	2
FLPL	0	0	3	3	6	1
MFT	0	0	15	7	8	0
Normal speech						
	Very good	Good	Satisfactory	Sufficient	Poor	Very poor
LC	0	3	1	4	4	0
FLPL	0	2	5	6	0	0
MFT	0	10	13	5	0	0

After laser cordectomy, respiratory symptoms occurred never (33%), rarely (25%) or occasionally (42%).

Influence of surgery on quality of life

Conventional surgery patients felt that their quality of life was not affected (15%), mildly affected (8%), moderately affected (62%), severely affected (8%), or extremely affected (8%) by the surgical procedure. Patients who underwent the modified technique felt not affected (12%), mildly affected (32%), moderately affected (32%) or severely affected (24%) by surgery. Laser cordectomy patients reported that their quality of life was not affected (33%), mildly affected (25%) or moderately affected (42%) (Table 8).

Aspiration

Of the patients who underwent the modified flap technique, 80% were able to return to oral eating after three days and 12% after five days. Only 8% (two patients) required prolonged tube feeding and swallowing therapy by a speech and language therapist. After two months, these patients too returned to oral food intake.

Those patients showed as well an aspiration in the transnasal laryngoscopy and the videofluoroscopy. A mild microaspiration without any clinical correlation was detected in four patients who underwent the modified flap technic.

Table 7: Assessment of voice quality by family and friends using a standardised questionnaire (LC = laser cordectomy, FLPL = frontolateral partial laryngectomy, MFT = modified flap technique)

How do your family and friends rate your voice quality?						
Soft speech						
	Very good	Good	Satisfactory	Sufficient	Poor	Very poor
LC	1	3	1	7	0	0
FLPL	0	3	4	6	0	0
MFT	1	12	9	5	1	0
Loud speech						
	Very good	Good	Satisfactory	Sufficient	Poor	Very poor
LC	0	3	1	3	4	1
FLPL	0	0	4	7	2	0
MFT	0	2	13	4	9	0
Normal speech						
	Very good	Good	Satisfactory	Sufficient	Poor	Very poor
LC	0	5	0	3	4	0
FLPL	0	2	5	5	1	0
MFT	1	10	10	5	2	0
Over the telephone						
	Very good	Good	Satisfactory	Sufficient	Poor	Very poor
LC	0	3	2	4	3	0
FLPL	0	1	4	4	3	0
MFT	0	7	14	5	2	0

Table 8: a: Assessment of quality of life by patients after laryngeal surgery (LC = laser cordectomy, FLPL = frontolateral partial laryngectomy, MFT = modified flap technique)
b: Subjective assessment of the degree of distress caused by the surgical procedure (LC = laser cordectomy, FLPL = frontolateral partial laryngectomy, MFT = modified flap technique)

Quality of life					
Do you feel your quality of life is affected by your disease?					
	Not affected	Mildly affected	Moderately affected	Severely affected	Extremely affected
LC	3	4	3	2	0
FLPL	1	4	3	4	1
MFT	2	7	12	6	1
Do you feel your quality of life is affected by the surgical procedure?					
	Not affected	Mildly affected	Moderately affected	Severely affected	Extremely affected
LC	4	3	5	0	0
FLPL	2	1	8	1	1
MFT	3	10	9	6	0

Tracheostomy

In 26 of the 28 patients who underwent the modified flap technique, the tracheostoma was closed within five to seven days. In the other two cases, the stoma was closed after 16 and 32 days respectively. In contrast, the tracheostoma was closed within seven days in 12 of the 13 patients who underwent conventional frontolateral partial resection and after 23 days in the remaining patient.

Discussion

Frontolateral partial resection for the management of T1 and T2 glottic carcinoma has been an established procedure for several decades. Alternative treatments have become increasingly popular only in recent years [6]. Whereas radiation therapy has become a common primary treatment option for early glottic carcinoma in Anglo-American countries, transoral laser resection has been increasingly used in Europe in the past two decades [1], [2], [6].

Open resection, however, can also have advantages over the aforementioned treatment alternatives. Compared with radiation therapy, for example, it allows R0 resection to be safely performed and resection margins to be pathohistologically examined. In terms of treatment duration, open resection compares favourably with radiation therapy, which lasts five weeks. Rehabilitation can be achieved rapidly after open surgery. Radiation therapy offers an option for the second-line treatment of recurrences [6].

Transoral laser resection is an elegant procedure and is oncologically safe if performed by an experienced surgeon. In some cases, the procedure can be carried out on an outpatient or day-case basis. Morbidity rates are low and tumour control (recurrence-free survival) rates are as high as 86% to 98% [6]. Primary glottic reconstruction, however, cannot be performed during laser surgery. At our institution, patients with T1 and T2 glottic tumours undergo frontolateral partial resection if rigid endoscopy is impossible for anatomical reasons. In agreement with other authors, suitable candidates for frontolateral partial resection are patients with unimpaired vocal fold mobility, tumours that do not extend further than the floor of the sinus of Morgagni in the cranial direction, and tumours with a maximum subglottic extension of 5 mm.

Unlike other authors, we exclusively use mucosa of the ipsilateral false vocal fold for the coverage of defects and the reconstruction of the neoglottis. This technique is characterised by a low level of invasiveness and leads to sufficient epithelialisation of the resection defect. In addition, the neocord that is created from mucosa forms a good phonating partner for the contralateral vocal fold and thus provides the basis for functional rehabilitation. Other authors reconstruct a neocord by imbricating and medialising thyroid cartilage strips [4], [7], [10] and report good or excellent voice rehabilitation. Imbrication tech-

niques can also be used during secondary reconstructions. A major advantage of primary reconstruction with the creation of a neoglottis is that compensatory false vocal cord phonation, which is difficult to unlearn, can be avoided [9], [12]. Alternatively, an injection technique can be used for scar augmentation and medialisation during a secondary procedure [5], [13], [14], [15].

The success of the treatment of early glottic carcinoma is determined not only by oncologic tumour control but also by functional results such as voice quality, swallowing function and the management of aspiration as well as post-treatment quality of life [16], [17], [18], [19], [20], [21]. During larynx-preserving surgery, a particular focus must therefore be placed on the preservation of function or functional reconstruction.

The outcomes of earlier techniques, especially those that involve leaving resection defects to granulate or covering defects with split-thickness skin grafts [22], were usually unsatisfactory in terms of respiration and phonation. Only when Conley introduced the use of false vocal cord flaps was it possible to reconstruct larger defects involving the vocal folds in a satisfactory manner [23], [24]. The main problem associated with the Conley method is the development of caudomedial scar tension that often leads to the medial displacement of the ipsilateral arytenoid into the laryngeal entrance. This results in a reduction of the diameter of the laryngeal entrance and thus a decrease in respiratory function. In addition, this technique adversely affects phonation since it leads to false vocal fold phonation or aryepiglottic phonation [9], [11]. A further disadvantage of this technique is the occasional absence of a sufficient amount of mucosa for the reconstruction of a neocord.

The modified procedure that we present here can counter these disadvantages. There are no major differences between the two techniques in terms of aspiration symptoms. Despite the forced mobilisation of the mucosa in the region of the posterior laryngeal entrance, none of the patients showed signs of aspiration during controlled swallowing. Only when they hastily swallowed fluids did minor aspiration occur occasionally.

Like other authors, we too are of the opinion that subjective ratings by the patients themselves and their families and friends as well as expert ratings of voice quality are more valuable than an analysis of voice range profiles [25], [26], [27], [28], [29]. This is also reflected in the results of the questionnaires. When voice quality was assessed in terms of roughness, breathiness and hoarseness [30], the voice quality of patients who underwent the modified flap technique was rated more positively than that of patients who underwent conventional surgery. Better voice outcomes were obtained in particular for soft speech and normal speech. This finding was confirmed by family members and friends who too rated the voice quality of patients who underwent the modified technique more favourably. The same applied to speech intelligibility over the telephone.

Compared with the modified flap technique, transoral laser resection led to similar phonatory outcomes. One

possible explanation is the absence of a neoglottis especially following the resection of large carcinomas of the vocal folds, which results in poor glottal closure and a breathy voice [17], [31].

Regardless of the type of resection or surgical procedure, the poorest voice outcomes were observed in the absence of a neocord. It was also noted that the presence of a neocord and sufficient glottal closure especially in the region of the anterior commissure played a major role in phonatory outcome. Similar findings were reported by other authors [3], [17], [19], [29], [31], [32].

The majority of patients who underwent reconstruction with a false vocal fold flap have a neocord that can come into contact with the healthy vocal fold during phonation. A comparison of patient-rated postoperative quality of life showed that patients who underwent laser resection had similar or poorer scores than patients who underwent open resection. This phenomenon, which is known as the satisfaction paradox in the literature, can be explained by different expectations [16], [18]. In general, patients who are candidates for transoral laser resection assume that they will undergo a minor easy-to-tolerate procedure associated with a short hospitalisation time. For this reason, they tend to expect a full recovery. After surgery, these patients perceive phonatory deficits, hoarseness or a lower tolerance to stressful situations more negatively and therefore rate their quality of life as relatively poor. By contrast, patients who undergo open surgery and thus a procedure that they consider as "real" surgery usually stay in hospital for five to seven days and often require temporary tracheostomy and tube feeding. They perceive their condition after closure of the tracheostoma and the return to oral food intake as a great improvement and therefore rate their quality of life positively.

None of the patients who underwent laser resection required tracheostomy and no patient developed aspiration. All open resection patients underwent tracheostomy for airway protection. The tracheostoma was closed in most cases after five to seven days. In only three cases was the tracheostoma closed no earlier than after 16, 23 and 32 days respectively. These patients had undergone extensive resection and forced mobilisation of the mucosa. This trauma led to persistent intralaryngeal oedema and an increased risk of aspiration that required prolonged tracheostomy for airway protection.

In other studies, too, frontolateral partial resection patients underwent temporary tracheostomy. Time to closure of the tracheostoma was reported to range between 2.2 and 4 days [7], [9], [10], [12]. Prolonged tracheotomy courses, however, were observed as well. One patient, for example, was decannulated only after four months [7].

When care is taken to preserve as much submucosa as possible, an impairment of sensitivity in the region of the laryngeal entrance and thus an increased risk of aspiration can be largely prevented. In our patient population, a feeding tube was routinely placed during surgery. Patients were consequently fed by a feeding tube for three days. On the fourth postoperative day, we performed a

water swallow test with the patient sitting in an examination chair. Patients who were able to swallow without aspiration returned to oral eating. In the other patients, tube feeding was continued for a further two days. Time to oral food intake was three days in 80% and five days in 12% of our patients who underwent the modified flap technique. Only 8% (two patients) required prolonged tube feeding and swallowing therapy by a speech and language therapist. After two months, however, these patients too returned to oral food intake. Similar results are found in the literature. Luna-Ortiz et al. reported that patients returned to oral eating after a mean period of 1.3 days and Har-El et al. reported that the vast majority of patients had oral food intake within two weeks [7], [10].

Summary

What is already known on the subject?

- If rigid laryngoscopy is possible, small carcinomas of the vocal folds can be easily removed by laser surgery in the majority of cases. This technique is associated with short hospitalisation times and low morbidity rates.
- Patients with tumours that extend to the anterior commissure and patients who cannot be treated by rigid laryngoscopy may require open resection.

What does this paper add to our understanding?

- The modified flap technique presented here involves the use of a false vocal fold flap for glottic reconstruction and the removal of arytenoid cartilage.
- It is a relatively simple method that allows surgeons to remove larger tumours and create a neocord that forms a good phonating partner for the contralateral vocal fold. This is reflected in the results of objective and especially subjective voice quality assessments.
- All three techniques show similar oncologic outcomes.
- An increased risk of aspiration or respiratory problems and a longer duration of tracheostomy were not noted.

Notes

Competing interests

The authors declare that they have no competing interests.

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Please cite as

Lorenz KJ, Kohnle R, Maier H. A modified false vocal fold flap for functional reconstruction after frontolateral partial laryngectomy: a comparison with conventional open resection and laser cordectomy. *GMS Interdiscip Plast Reconstr Surg DGPW*. 2013;2:Doc14.
DOI: 10.3205/iprs000034, URN: urn:nbn:de:0183-iprs0000343

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Published: 2013-10-23

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Corresponding author:

Kai J. Lorenz, MD, Assistant Professor
Department of Otolaryngology/Head and Neck Surgery,
German Armed Forces Hospital of Ulm, Oberer Eselsberg
40, 89081 Ulm, Germany, Tel.: +49 (0) 731 1710 1501,
Fax: +49 (0) 731 552767
Kai.lorenz@extern.uni-ulm.de